

WHAT IS CLAIMED IS:

- 1 1. A system for determining an arterial blood
2 constituent of a patient, comprising:
3 a processing device in communication with a detector
4 to process a detector signal from said detector
5 representing a noncardiac produced blood pulse for
6 determination of said blood constituent.
- 1 2. The system of claim 1 wherein at least two
2 points on said detector signal are used.
- 1 3. The system of claim 1 further comprising:
2 a sensor for attaching to said patient, including a
3 radiation emitter and a radiation detector.
- 1 4. The system of claim 3 wherein said sensor
2 comprises a sensor body containing said emitter and said
3 detector configured to fit entirely on a nail of a patient
- 1 5. The system of claim 3 further comprising a
2 stimulator configured to create an artificial pulse in said
3 patient.
- 1 6. The system of claim 3 wherein said sensor is a
2 reflectance sensor.
- 1 7. The system of claim 6 wherein said emitter and
2 said detector are separated by less than 10 millimeters.
- 1 8. The system of claim 3 wherein said sensor
2 includes a sensor body preformed to conform to the curvature
3 of a nail.
- 1 9. The system of claim 3 wherein said detector
2 detects reflectance signals from said sensor, and further

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3 comprising at least one additional optical element mounted in
4 said sensor body to facilitate transmittance signals.

1 10. The system of claim 9 wherein said additional
2 optical element is an additional radiation detector.

1 11. The system of claim 9 wherein said additional
2 optical element is an additional radiation emitter.

1 12. The system of claim 9 further comprising means
2 for cross-reference calibration of said reflectance and
3 transmittance signals during periods of minimal motion.

1 13. The system of claim 1 wherein said processing
2 device further comprises:

3 a first processing unit configured to determine
4 a physiological parameter from a cardiac derived
5 plethysmogram from said detector; and

6 a second processing unit configured to
7 determine said physiological parameter from a motion
8 artifact waveform from said detector.

1 14. The system of claim 13 further comprising a
2 control unit configured to utilize said first and second
3 processing units responsive to a motion artifact content of
4 said detector signals.

1 15. The system of claim 14 wherein said control
2 unit is configured to switch between said first and second
3 processing units.

1 16. The system of claim 14 wherein said control
2 unit is configured to combine signals from said first and
3 second processing units.

1 17. The system of claim 3 wherein said sensor is an
2 oximeter sensor.

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1 18. A reflectance optical sensor comprising:
2 a sensor body configured to attach to a
3 patient's digit over a nail;
4 a radiation emitter mounted in said sensor body
5 adjacent said nail; and
6 a radiation detector mounted in said sensor
7 body spaced from said emitter and adjacent said
8 nail.

1 19. The sensor of claim 18 further comprising an
2 adhesive for attaching said sensor body to said nail, and
3 wherein said sensor body is configured to fit entirely on said
4 nail.

1 20. The sensor of claim 18 further comprising a
2 portion of said sensor off said nail.

1 21. The sensor of claim 18 wherein said emitter
2 comprises a fiber optic light guide.

1 22. The sensor of claim 18 wherein said detector
2 comprises a fiber optic light guide.

1 23. The sensor of claim 18 wherein said sensor body
2 is rigid and preformed to the curvature of a nail.

1 24. The sensor of claim 18 wherein said sensor body
2 is deformable to adapt to the exact curvature of a nail.

1 25. The sensor of claim 18 wherein said emitter and
2 said detector are recessed within said sensor body.

1 26. The sensor of claim 18 wherein said sensor body
2 provides a numerical aperture of less than 0.9 for radiation
3 emitted from said emitter and detected by said detector.

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1 27. The sensor of claim 18 wherein said sensor body
2 provides a numerical aperture of less than 0.5 for radiation
3 emitted from said emitter and detected by said detector.

1 28. The sensor of claim 18 further comprising a
2 cylindrical lens mounted adjacent said emitter.

1 29. The sensor of claim 18 wherein said sensor body
2 is at least partially absorbing for at least one wavelength of
3 said emitter for at least a portion of a region of said sensor
4 body between said emitter and said detector.

1 30. The sensor of claim 18 further comprising:
2 a cable attached to said sensor providing a
3 connection to said emitter and said detector; and
4 a strap configured to attach said cable to a digit
5 adjacent said sensor for strain relief of said cable.

1 31. The sensor of claim 30 wherein said cable
2 includes a fiber optic cable connected to at least one of said
3 emitter and said detector.

1 32. The sensor of claim 30 wherein said cable
2 includes a flexible circuit connected to at least one of said
3 emitter and said detector.

1 33. The sensor of claim 18 wherein said detector is
2 mounted within 10 millimeters of said emitter.

1 34. The sensor of claim 33 wherein said detector is
2 mounted approximately 4 millimeters from said emitter.

1 35. The sensor of claim 18 wherein said emitter and
2 detector are mounted more orthogonal than parallel to an axis
3 of said digit.

1 36. The sensor of claim 18 wherein said emitter and
2 detector are mounted more parallel than orthogonal to an axis
3 of said digit.

1 37. The sensor of claim 18 wherein said emitter and
2 detector are spaced and positioned so that both will not be
3 over the lunula of a nail when attached.

1 38. The sensor of claim 18 wherein said sensor body
2 includes a portion for contacting a portion of said digit off
3 said nail.

1 39. The sensor of claim 18 wherein said sensor is a
2 pulse oximeter sensor.

1 40. An optical sensor comprising:
2 a sensor configured to attach to a patient;
3 an emitter connected to said sensor;
4 a detector connected to said sensor and spaced from
5 said emitter to detect reflectance signals; and
6 at least one optical element connected to said
7 sensor to facilitate transmittance signals.

1 41. The sensor of claim 40 further comprising:
2 processing means for utilizing said
3 transmittance signals to process signals produced
4 predominantly by cardiac pulses, and utilizing said
5 reflectance signals to process signals produced
6 predominantly by non-cardiac blood pulses.

1 42. The sensor of claim 40 further comprising:
2 means for allowing the selective activation of said
3 detector to use said reflectance signals in the presence
4 of motion.

1 43. A photometric device for processing detector
2 signals representative of a blood property of a patient from a
3 sensor attached to said patient, said sensor including a

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radiation emitter and a radiation detector, said monitor comprising:

a control unit configured to generate an activation signal to selectively activate said emitter; and

a processing unit configured to receive said detector signals and to process said detector signals utilizing at least two points on a detector signal waveform produced by motion of said patient for measurement of said blood property.

44. A photometric processing device for processing detector signals from a radiation detector in a patient sensor also having a radiation emitter, comprising:

a first processing unit configured to determine a blood parameter from a cardiac derived plethysmogram from said detector;

a second processing unit configured to determine said blood parameter from a motion artifact waveform from said detector; and

a control unit configured to utilize said first and second processing units responsive to a motion artifact content of said detector signals.

45. The photometric processing device of claim 44 further comprising a processor and a memory, wherein said first and second processing units and said control unit are first, second and third programs stored in said memory.

46. A photometric processing device for processing detector signals from a detector in a patient sensor having an emitter and a detector, comprising:

a stimulator configured to generate an artificial pulse in said patient, said artificial pulse being distinct from a cardiac derived arterial pulse; and

a processing unit configured to determine a physiological parameter of arterial blood from a signal from said detector representative of said artificial pulse.

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1 47. The device of claim 46 wherein said
2 physiological parameter is arterial oxygen saturation.

1 48. The device of claim 46 wherein said stimulator
2 induces movement of an appendage of said patient.

1 49. The device of claim 46 wherein said stimulator
2 comprises an inflatable bag and an attachment mechanism
3 configured to attach said bag to one side of an appendage of
4 said patient.

1 50. The device of claim 46 further comprising a
2 bandpass filter coupled to receive a signal from said
3 detector, said bandpass filter passing one of an amplitude,
4 phase and frequency of said stimulator, wherein said
5 distinction is one of an amplitude, phase and frequency.

1 51. The device of claim 50 wherein said frequency
2 can be changed.

1 52. The device of claim 46 further comprising a
2 frequency generator coupled to said stimulator.

1 53. The device of claim 52 wherein said frequency
2 generator is configured to vary an output frequency.

1 54. A photometric processing device for processing
2 detector signals from a detector in at least one patient
3 sensor having an emitter and a detector, comprising:
4 a selector configured to select between a
5 reflectance signal and a transmittance signal from
6 said at least one sensor; and
7 a processing unit configured to determine a
8 physiological parameter from a plethysmogram from
9 said at least one sensor.

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1 55. The device of claim 54 further comprising:
2 a first processing unit configured to determine a
3 physiological parameter from a cardiac derived
4 plethysmogram from said detector;
5 a second processing unit configured to determine
6 said physiological parameter from a motion artifact
7 waveform from said detector; and
8 a control unit configured to switch between said
9 first and second processing units in accordance with a
10 selection of said selector.

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1 56. The device of claim 55 wherein said selector is
2 responsive to a motion artifact content of a detector signal
3 from said at least one sensor.
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5 57. A method of measuring arterial oxygen
6 saturation, comprising the steps of:
7 selecting a site on a patient wherein detected light
8 signals from at least two wavelengths are sufficiently
9 correlated in the presence of motion;
10 placing a pulse oximeter sensor on said site; and
11 measuring arterial oxygen saturation using said
12 sensor.

1 58. The method of claim 57 wherein said light
2 signals produce a closed Lissajous.

1 59. The method of claim 57 wherein said
2 sufficiently correlated signals produce an arterial oxygen
3 saturation that is accurate within 15 saturation points.

1 60. The method of claim 57 wherein said
2 sufficiently correlated signals produce an arterial oxygen
3 saturation that is accurate within 10 saturation points.

1 61. The method of claim 57 wherein said oxygen
2 saturation is measured by analyzing at least two points on a
3 waveform generated by motion of said patient.

1 62. A method for measuring a property of blood,
2 comprising the steps of:

3 selecting a site on a patient wherein propagated
4 light of at least two wavelengths will have sufficiently
5 correlated waveforms in the presence of non-cardiac
6 pulses;

7 placing a light emitter and light detector on said
8 site; and

9 using signals derived from said light detector to
10 measure said blood property.

1 63. The method of claim 62 wherein said signals
2 include predominately motion-induced variations and said site
3 is a nail on a digit.

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